

National Aeronautics and Space Administration

Office of Space Science

SPACE SCIENCE ADVISORY COMMITTEE

July 28–30, 2004

**Shelter Pointe Hotel and Marina
1551 Island Drive
San Diego, California**

MEETING REPORT

Marc S. Allen
Executive Secretary

Andrew B. Christensen
Chair

SPACE SCIENCE ADVISORY COMMITTEE (SScAC)

July 28–30, 2004
 Shelter Point Hotel and Marina
 San Diego, California

MEETING REPORT
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Wednesday, July 28, 2004Welcome and Opening Remarks

Dr. Andrew Christensen, chair of the Space Science Advisory Committee (SScAC), welcomed the members and visitors.

Space Science Status Report from the Associate Administrator

Dr. Edward Weiler, NASA Associate Administrator for Space Science, provided a retrospective on the Office of Space Science (OSS) since he became Associate Administrator, as well as the usual status update on OSS programs and missions. He described his vision for OSS as seeking answers to four questions: How did the universe begin? How did we get here? Where are we going? Are we alone? These questions communicate the motivation of space science even to a nonscientific audience. They can provide the foundational understanding to guide the NASA vision and mission, as expressed in the 2003 NASA vision statement. The three themes proposed by the President's Commission on Space Exploration (Aldridge Commission) to guide space exploration—origins, evolution, and fate—are consistent with what the Space Science Enterprise has been doing for the past six years. Dr. Weiler discussed the specific findings and recommendations of the Aldridge Commission and their implications for NASA and space science.

Dr. Weiler described the transformed structure of NASA, which now has four mission directorates and six mission support organizations. At the level of mission directorates, the major changes were the merger of the Office of Space Science and the Office of Earth Science into one Science Mission Directorate (SMD). The NASA Deputy Administrator now has the title of Chief Operating Officer. There is a new position of Associate Deputy Administrator for Systems Integration, which will be held by Mary Kicza. The most senior professional scientist in the NASA leadership will be Dr. Ghassem Asrar, who will now be Deputy Associate Administrator of the SMD.

Public interest in space science and NASA's role is illustrated by the recent cover of *National Geographic* highlighting Sun–Earth science and by the extent of Internet and media interest in the Mars Exploration Rovers (MERs). Dr. Weiler reviewed other recent achievements in space science from Cassini and Chandra, as well as major upcoming events including mission launches. Genesis sample return is on September 8, and the Huygens probe separation and descent is scheduled for December–January. OSS has been averaging 5 launches per year.

From FY 1998 to FY 2005, the OSS budget tripled, and the budget increases reflect the importance of communicating science discoveries to the public. Overall program control returned from the NASA Centers to Headquarters, and the Headquarters staff doubled. Using the *Science News* contributions to world discoveries and technological achievements during 2003 as a metric, space science accounted for 79 percent of the NASA items in that list. In summary, Dr. Weiler said that space science is on a solid foundation for future exploration of the solar system and the universe, with a recent history of an increasing budget and 85 percent of missions from 1993 to date successfully launched. Science has driven every decision to explore the universe, and it is the job of the science communities to ensure that science continues to play a role in the Exploration Vision.

During the question period, Dr. Weiler said that exciting science needs to be done to encourage the next generation of space scientists. The space science roadmap should be aligned with what the Aldridge Commission said about NASA's science mission. The community needs to work on communicating the relationship between exploration and science. With respect to changes in funding lines, Dr. Weiler said that the theme boundaries were good for marketing programs but less beneficial for managing them. He hopes the distinction between funding for manned and unmanned programs is maintained. The SScAC and Dr. Weiler discussed coordination between the SMD and the Exploration Systems Mission Directorate (ESMD), which has responsibilities for both manned and robotic missions. In honoring Dr. Weiler for his service as Associate Administrator, Dr. Christensen said that Dr. Weiler's focus on science and competitive peer review in OSS programs fostered a period of peace and prosperity for space science. Dr. Christensen expressed hope that the focus on peer review and science will remain.

Division Reports

The SScAC heard status briefings from the Directors of the Astronomy and Physics Division (APD), Solar System Exploration Division (SSED), and Sun-Earth Connections Division (SECD).

APD Status Update. Dr. Anne Kinney, APD Director, said that the APD was less affected by the transformation than other OSS divisions. A major issue is the future of the Structure and Evolution of the Universe (SEU) programs, particularly with the reduction in budget for the Beyond Einstein Program in the President's FY 2005 Budget Request. Another major area of concern is extending the operating life of the Hubble Space Telescope (HST) and optimizing its science program. The servicing and deorbiting mission responsibilities for HST have been moved to the ESMD. Five reviews related to HST have been done this year.

Significant recent events in the APD include launch of Gravity Probe B (GP-B) on April 20. GP-B science operations are scheduled to begin in August 2004. NASA Space Science Updates were done on results from the Chandra X-ray Telescope and the Spitzer Infrared Telescope. Concept studies for Origins Probes were initiated, with 26 proposals received.

The rapid development of coronagraph technology has led to reformulation of the Terrestrial Planet Finder (TPF) mission as two missions. Under this reformulation, an earlier coronagraph TPF mission (TPF-C), to be launched around 2014, will precede an interferometer TPF mission (TPF-I), to be launched around 2019. Dr. Kinney noted that the Origins Subcommittee (OS) and the Structure and Evolution of the Universe Subcommittee (SEUS) of the SScAC had spent considerable time in their meetings earlier in the week discussing the TPF reformulation. The TPF program is particularly responsive to the planet finding objective in the Exploration Vision, and the reformulation allows a TPF mission to be launched several years earlier than previously planned. Discussions between GSFC and JPL on TPF and the Laser Interferometer Space Antenna (LISA) have clarified the lines of authority and led to agreement on collaboration between the two NASA Centers. A full team of partners is now under contract for developing the James Webb Space Telescope (JWST).

The top budget concerns for the APD include the possibility that SMD will be required to fund some portion of an HST servicing mission. Funds were added to the LISA budget to cover spacecraft and payload integration, which should help negotiations with the European Space Agency (ESA). The launch slip for the Swift Gamma-Ray Burst Explorer (Swift) and increasing costs on Planck and Herschel will affect the budget. Reserves had to be increased for the Gamma-ray Large Area Space Telescope (GLAST) to pass its confirmation review. The Russian

RadioAstron mission continues to be a potential budget drain because the U.S. commitment for it has no sunset clause. There will be support from the SEU theme budget for initial concept work with the Department of Energy (DOE) on the Joint Dark Energy Mission (JDEM). Expendable launch vehicle (ELV) costs are increasing for GLAST, LISA, and the Space Interferometry Mission (SIM). The APD budget has also been squeezed by late charges from the NASA Centers under the new full cost accounting system.

The project team for the Stratospheric Observatory for Infrared Astronomy (SOFIA) recently submitted a major increase in the estimated annual operating budget to conduct “great observatory”-class operations. The requested increase is \$15 million to \$20 million per year above the \$55 million per year in the budget plan for the twenty years of SOFIA operation. Dr. Kinney described the questions she posed to the SEUS and OS for input from the science communities to aid NASA in making a decision on the project’s budget request: (1) How important is it for SOFIA to start science operations soon (November 2005)? (2) What is the proper scope of SOFIA science operations? (3) From where (in the APD budget) should any increase in SOFIA funding come? An alternative to approving the increase is to return SOFIA to a Principal Investigator (PI) mode mission, without a robust guest observer program, facility instruments, versatile data archive, and other aspects of a great observatory mission.

Dr. Kinney listed the eleven NASA Space Science Updates and teleconferences on APD operating missions in the past year and emphasized the importance of maintaining attention in the Universe Division on education and public outreach (E/PO).

All of the APD operating missions have “green” project status, and three major observatories (HST, Chandra, and Spitzer) are doing science. Among the APD missions in development within the Origins theme, the nuller for the Keck Interferometer has been shipped to Hawaii for integration and test. The draft Environmental Impact Statement for the Keck outrigger telescopes was released in July. The Kepler project has “yellow” status, with bonding of the charge-coupled devices (CCDs) to carriers still an issue. Cost growth and reserve issues will have to be solved before Kepler can pass its Confirmation Review. An updated cost proposal from the contractor for phases B, C, and D of SIM has substantial cost increases. JWST is “yellow” because approval has not yet been obtained to use a European launch vehicle (the Ariane 5), which the European Space Agency (ESA) had offered to provide.

Among the SEU theme missions in development, GP-B, Swift, Astro-E2, GLAST, and Herschel all have “green” status. Temperature fluctuations in the cryocooler are still a problem for Planck. Dr. Kinney expects that ESA will cancel the Extreme Universe Space Observatory (EUSO) mission because the Shuttle is not available to fly it to the International Space Station (ISS).

With respect to science centers funded through the APD, Dr. Kinney is talking with the National Research Council (NRC) about reviewing the four large science centers and recommending the best way to manage them. Of five future science centers, those for GLAST and JWST were not competed, those for Swift and SOFIA were competed with the mission project. The science center for TPF will be competed, although the mechanism for doing so has not been worked out. Dr. Kinney reviewed the current work force sizes, budgets, and responsibilities of the current science centers.

Dr. Kinney reviewed the funding in the APD since 1990 for research and analysis (R&A) and guest observer programs. A next step in presenting data on R&A to the SEUS and OS will be to show the amounts of funding to university-based investigators and to the NASA centers. Dr. Kinney listed the Research Opportunities in Space Science (ROSS) announcements during the

previous quarter. Thirteen NASA Research Announcements (NRAs) were released by the APD so far in calendar 2004, many of which use multiple panels as part of the peer review process for award selection.

Dr. Kinney answered questions from SScAC members on HST instrument installation as part of a robotic servicing mission and the status of the agreement with ESA on a TPF interferometer mission. Other OSS staff responded to SScAC concerns about the replacement for technology development programs lost when the Office of Aerospace Technology was reorganized.

SSED Status Update. Mr. Orlando Figueroa included the Mars Exploration Program (MEP) and the Robotic Lunar Exploration Program (RLEP) in his briefing to the SScAC. Among recent accomplishments in the SSED, Mr. Figueroa highlighted completion of Genesis sample collection, establishment of a program office for the RLEP at GSFC, and the release on June 18 of an Announcement of Opportunity (AO) for the Lunar Robotic Orbiter (LRO) mission, which is planned for 2008. Two candidate missions were selected to enter phase A for the second New Frontiers mission. The Moonrise concept is for a mission to the Lunar south pole and Aitken Basin. The Juno concept is a Jupiter orbiter mission. Peer reviews of subsystems on the Kepler spacecraft have begun, in preparation for Kepler's preliminary design review (PDR) and non-advocate review (NAR) in October.

Among issues and concerns, Mr. Figueroa noted that launch vehicle certification and the stand-down at Los Alamos National Laboratory pose challenges to the scheduled launch of New Horizons in 2006. The Discovery/New Frontiers Program Office is being moved from JPL to Marshall Space Flight Center (MSFC). Adjustments for full cost accounting continue to erode program budgets across the division. The Discovery Program is returning to a healthier budget status, although some threats remain. Among these threats are Kepler cost issues and the delayed launch of the Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) mission from May until August because of technical issues. A delay in launch of New Horizons to 2007 could put cost pressure on the next New Frontiers mission.

The Jupiter Icy Moons Orbiter (JIMO) Science Definition Team's report on spacecraft and mission requirements is complete. Mr. Figueroa is concerned that the budget profile for JIMO could have negative effects on the launch schedule and the content of the project. The Deep Space Network (DSN) is performing well in supporting the multiple missions underway; a long-term strategic plan for the next-generation DSN is being developed.

Among solar system exploration missions, Cassini-Huygens is doing well in Saturn orbit. The Cassini imagery will continue to improve as the mission progresses. The MESSENGER mission has made tremendous progress and is on schedule for launch on August 2. The Genesis team is preparing for sample return, with one more major maneuver to prepare for reentry of the sample capsule in September. Mr. Figueroa described the plans for helicopter capture of the capsule as it descends by parachute to the recovery area in Nevada. Deep Impact is scheduled for launch in December, with its asteroid encounter in July 2005.

Among the missions operating at Mars, the Mars Express spacecraft is doing well, but activation of the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) has been postponed until a concern about antenna deployment is resolved. An analysis of deployment dynamics is expected to be complete by the end of August. Assembly, test, and launch operations (ATLO) has begun for the Mars Reconnaissance Orbiter (MRO). The Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), a major MRO instrument, is ready to be shipped, but the High-Resolution Imaging Science Experiment (HiRISE) continues to have technical

problems. HiRISE development is now driving the MRO project schedule. Reserves from MEP will be released next year to recover MRO reserves. MRO and other missions are facing costly decisions about replacing or keeping the flawed field-programmable gate arrays (FPGAs) used in their microprocessing assemblies. An instrument AO has been released for the Mars Science Laboratory (MSL). Planetary protection and instrument selection remain major issues for MSL development. The optical communications demonstration on the Mars Telecommunications Orbiter (MTO) is progressing but remains a significant challenge. The Mars Exploration Rovers (MERs) completed their primary mission in April and are in their first mission extension. The budget impact of extending the MERs to June 2005 is an issue that the MEP will need to address by September. The facility studies for a Mars sample return facility have been completed.

Mr. Figueroa highlighted the major discoveries from the Spirit and Opportunity MERs. These MER discoveries are leading the program to reconsider elements in the Next Decade exploration pathways for Mars, such as adding some roving capability to the Ground-breaking Sample Return (GSR) mission concept. The MER scientists believe there are additional major discoveries to be made as Spirit explores the Columbia Hills bedrock outcrops.

In response to SScAC questions, Mr. Figueroa discussed the relationship between the science goals of the Moonrise mission concept, as part of the New Frontiers program, and the RLEP, which is aimed at preparing for human missions to the Moon. He said the SSED is working on potential linkages between its technology development needs to support science missions and technology development in ESMD for exploration needs. The increased cost for MESSENGER in phase E will come out of Discovery program reserves, which will delay future Discovery missions. To meet its mass margins, the Dawn project deleted one instrument. The primary science objectives were preserved, as well as Dawn's visit to two complementary objects. Mr. Figueroa sees no threat to the R&A budget for astrobiology because the search for life is an important objective within the Exploration Vision. The ESMD appears to be committed to moving JIMO/Prometheus technology development forward to meet mission challenges. In response to Dr. Christensen's final question on challenges for the New Horizons schedule. Mr. Figueroa reviewed the list of issues: qualification of the solid rocket motor booster, launch vehicle certification, and the security-related stand-down of plutonium pellet production at Los Alamos National Laboratory. The stand-down could last from weeks to months.

SECD Status Update. Dr. Richard Fisher, SECD Director, began by thanking the science advisory committees for their help in guiding SECD program decisions. He then reviewed the changes to SECD program funding with the FY 2005 Budget Request. Phase C/D of the Magnetospheric Multiscale mission (MMS), which was the highest priority SEC mission in the NRC *Decadal Survey*, is now delayed until after FY 2010. Two other Solar Terrestrial Probe (STP) missions, Geospace Electrodynamics Connections (GEC) and Magnetospheric Constellation (MagCon), were delayed beyond the five-year budget horizon. The Living with a Star (LWS) program was not affected by budget changes. A major change in the budget was funding for mission operation and data analysis, which will force a reduction in operating missions in the SEC fleet. A Senior Review will be conducted early to make the decisions on which extended operating missions to terminate. The Sounding Rocket Program was frozen at a level that has serious consequences for the scope and nature of that program. Dr. Fisher's later presentation on the program provided details on a restructuring that would preserve its major functions, albeit at lower levels.

The four Explorer missions in development, Swift, Time History of Events and Macroscale Interactions during Substorms (THEMIS), Widefield Infrared Survey Explorer (WISE), and Aeronomy of Ice in the Mesosphere (AIM), all have "green" overall project status. The Extreme

Universe Space Observatory (EUSO) is an ESA mission with Explorer funding as a mission of opportunity. Without the Shuttle to carry it to the ISS, its future is uncertain. An ESA decision on whether to proceed with EUSO is expected in November.

The New Millennium Technology Program provides flight validation of new technology. ST-5 was replanned in March for a dedicated Pegasus launch vehicle in 2006. ST-6, the Inertial Stellar Compass (ISC), may have a ride on the Air Force Research Laboratory's Roadrunner, now that a Shuttle launch is no longer an option. ST-7 is at risk because cost growth in Stanford University's development of the Gravitational Reference Sensor exceeds the \$64 million cost cap. There is also a schedule delay due to an ESA delay with the host spacecraft, SMART-2. The project will present its replan to Headquarters in August. ST-8 selections for phase A have been made, and downselect is scheduled for March 2005. An AO for ST-9 has been approved. There are notional plans for subsequent New Millennium missions, although the rate may be adjusted now that launch vehicle costs need to be included in the budget profile.

The next mission in the STP program, Solar B, is a joint mission with the Japanese Aerospace Exploration Agency (JAXA). It has had a series of mishaps and delays that are putting pressure on the overall STP budget. The project is recovering from an error in the x-ray telescope mirror and is still experiencing delays on the focal plane package. An Independent Performance Review of the Solar Terrestrial Relations Observatory (STEREO) on June 23-24 evaluated the project's schedule, cost, and technical performance since its January 2004 rebaselining. A final report on STEREO is due in mid-August. STEREO is also facing a decision on replacing its flawed FPGAs. The STP budget reductions and STEREO cost growth have pushed the start on MMS to FY 2007.

In the LWS program, the Solar Dynamics Observatory (SDO) was confirmed to begin implementation on June 1 and is on track for a Critical Design Review (CDR) in February 2005. Launch is scheduled for early 2008. SDO will be the foundation of a new space weather observing fleet. Dr. Fisher delayed release of an AO for the two Geospace Missions because of uncertainties in funding and Agency support.

Dr. Fisher reviewed the top project/program risks for all SECD missions in development. He then discussed major SECD issues. One major issue is the impact of budget changes on SECD programs and the operating fleet of SEC spacecraft. A related issue involves future requirements to provide space weather warnings and forecasts to support human exploration missions in the ESMD.

In response to SScAC question, Dr. Fisher explained the operational role of the National Oceanic and Atmospheric Administration (NOAA) in producing space weather forecasts and the supporting role that SECD research data play by being openly available to NOAA forecasters. In response to an SScAC question, Dr. Fisher said there are no plans to continue tracking or using the Genesis spacecraft in a research capacity after it releases its solar wind sample capsule for Earth return. The Genesis PI submitted a proposal to the 2003 Senior Review for continued observations using the spacecraft, but the proposal was not accepted. With respect to the Heliospheric Sentinels project, for which a science definition team is being formed, Dr. Fisher believes they will have Agency priority as monitors for space weather at other bodies of interest to human exploration objectives. Given this interest, they appear likely to be launched in time to have some overlap with other solar observing missions.

Subcommittee Reports

Dr. David Spergel, chair of the OS, reported on his subcommittee's meeting just prior to the SScAC meeting. The OS endorsed the revision to TPF and expressed excitement about achieving, in the next decade, the Origin theme's goal of detecting and characterizing Earth-like planets. The OS strongly recommended that the SScAC recommend including two auxiliary science instruments on TPF-C to maximize the science return. The subcommittee also endorsed the TPF plan to encourage a broad range of potential instruments in an open competition.

With respect to SOFIA, the OS recommended an SScAC position that operations begin as soon as possible. The OS did not endorse the project's request for a FY 2005 budget supplement at this time, prior to the NASA reviews in September and a bottom-up evaluation to find cost savings. Dr. Spergel explained that the OS discussion had divided the project budget request into an early-year funding increment to deal with development and implementation issues and a longer-term increment to sustain operations as a facility-class instrument. The OS had agreed that the longer-term funding issue should be evaluated, as part of the roadmapping process, in the context of trades available within the SOFIA project and trades of SOFIA objectives with other Origins priorities.

The OS was concerned about support for technology development. With the disappearance of the Office of Aerospace Technology programs for developing technology from early to intermediate Technology Readiness Levels (TRLs), the support for technologies needed for Origins science appears to be missing. Because this is probably a common problem across space science, the OS urged the SScAC to review the situation. With respect to the reorganization of space science, the OS members were looking forward to working with their colleagues from the SEUS in supporting the new Universe Division of the SMD. It will be reasonable to work on a combined roadmap. The final OS letter to the chair of the SScAC is attached as Appendix E.

Dr. James Clemmons, representing the Sun-Earth Connection Advisory Subcommittee (SECAS), reported on that subcommittee's meeting earlier in the week. The SECAS favors adding a NASA Level 0 requirement for an end-to-end predictive capability, based on observations and modeling, for solar system environmental conditions. In a joint finding with the Solar System Exploration Subcommittee (SSES), the SECAS endorsed the plan for changes to the sounding rocket program to respond to the resource changes in the FY 2005 budget request. The plan by the operations contractor to move to lower-performance vehicles will not support the science that the user community wishes to conduct.

The SECAS found considerable opportunity for collaboration and common interests between the planetary science and Sun–Earth connections communities and recommended that these communities explore synergistic research opportunities. The fourth SECAS finding urged stronger efforts to increase the intra-agency programs and interagency coordination on space science theory and modeling, in line with recommendations in the NRC *Decadal Survey*. With respect to space science E/PO, the SECAS found that the current focus on primary and secondary education (K-12) programs should be augmented with activities aimed at higher levels of education. A specific goal of these added activities should be to attract students to space science. On the Senior Review that will be used to determine which SEC operating missions are terminated after their current mission extensions end, the SECAS asked that the evaluation criteria continue to include consideration of maintaining a multi-mission system-science approach to solar system observations. The SECAS requested early release of information about the AO for the LWS program to aid potential proposers in forming teams and preparing better proposals. The final SECAS letter to the chair of the SScAC is attached as Appendix F.

Dr. Edward Kolb, SEUS chair, began his report with an overview of SEU science and the formulation of the Beyond Einstein initiative in the previous version of the SEU roadmap. The SEU reductions from previous plans in the FY 2005 Budget Request will delay LISA by at least one year. Con-X will be delayed by several years, and the Einstein Probes are now beyond the five-year planning horizon. The report this spring of the National Science and Technology Council (NSTC) Interagency Working Group on Physics of the Universe used the Beyond Einstein roadmap extensively in formulating the Federal interagency response to the NRC report, *Connecting Quarks with the Cosmos*. The NSTC report recommended, as its highest priority, that NASA and the DOE undertake a JDEM project. Although neither NASA nor DOE has funding for JDEM, formation of a joint science definition team has been announced. Dr. Kolb noted portions of the Aldridge Commission report that include science questions within the SEU area as aspects of exploration-relevant science. On the advice of the Astronomy and Astrophysics Advisory Committee (AAAS)—which reports to Congress and to the heads of NASA, NSF, and DOE on all Federally funded research in astronomy and astrophysics—an interagency Dark Energy Task Force is being created to formulate a ground-based R&D program to prepare for a future JDEM. Dr. Kolb noted other recommendations in the NSTC report that support the elements of the Beyond Einstein program as previously planned and budgeted. (The NSTC report, *A 21st Century Frontier of Discover: The Physics of the Universe*, is available online at <http://www.ostp.gov/html/physicsoftheuniverse.pdf>.)

Among the issues discussed by the SEUS at its meeting earlier in the week were the consequences of merging the SEU and Origins themes and the best strategy for updating the SEU-related portions of a Universe Division roadmap. The SEUS also discussed how to make the best use of the NSTC report, how to respond to the Aldridge Commission report, the role of SEU science in the Exploration Vision, and the implications of these questions for an SEU roadmapping strategy. In response to its first detailed briefing on SOFIA and Dr. Kinney's questions, the SEUS concluded that the primary objective should be to get SOFIA flying, then consider if augmentations are supported, using the proven processes of senior reviews, roadmapping, etc., to consider the project's requests relative to other uses of limited Universe Division resources. The final report from the SEUS to the SScAC chair is included as Appendix G.

Dr. Jonathan Lunine, chair of the SSES, reported on the meeting of his subcommittee earlier in the week. He described the roadmapping process being used by the SSES, with four subgroups for the major science areas to be included. At this meeting, members of the SECAS were added to three of the subgroups to explore areas of interest to both the planetary science and Sun-Earth Connection science communities. Dr. Lunine noted that the MER discoveries support the SSES finding that the Next Decade robotic explorations of Mars should focus on the search for evidence of past life. At future meetings, the SSES will work with the Mars Exploration Program Analysis Group (MEPAG) on integrating the augmentations in the FY 2005 budget request with the Next Decade planning for robotic missions. With respect to the New Horizons mission and JIMO, the SSES is concerned about the potential for major delays in pursuing outer planet explorations that reflect the priorities of the latest NRC *Decadal Survey*. After Cassini-Huygens, the gap between periods with science mission operations underway at an outer planet is likely to increase from one or two years during the past several decades to six years or more.

The SSES was pleased with the efforts of the SSED and the Discovery Program to bring better project management discipline to the missions in development. There was concern about the movement of the Discover/New Frontiers Program Office to MSFC from JPL, and the SSES has requested a briefing from the new project office. The SSES confirmed its prior position that maintaining cost estimates within the mission cap should be a criterion for confirmation to

proceed to implementation. With respect to the future DSN, the SSES favored pursuing more than one solution to deep space communications because of differences in the kinds of data communications issues and constraints that missions will confront in the future. The subcommittee found that NASA should make the technology investments to implement the DSN roadmap. The SSES heard an update on the Planetary Data System (PDS) archive and formulated findings on maintaining and improving its capabilities. The final report from the SSES to the SScAC chair is included as Appendix H. Dr. Lunine responded to SScAC comments about future Scout missions to Mars, DSN data rates, and the Aldridge Commission report as a basis for roadmapping strategy.

Thursday, July 29, 2004

GPRA 1: OS and SEUS Presentations and Discussions

Dr. Marc Allen, Executive Secretary of the SScAC, described NASA's reporting requirements under the Government Performance and Results Act (GPRA) and the current procedure for advisory committee input to the assessment of science performance goals. The timing to present the annual performance goal (APG) assessment report to Congress after internal NASA reviews requires that the SScAC provide its input at this meeting, rather than after the fiscal year ends. Dr. Allen explained the process by which the SScAC subcommittees had reviewed the staff-prepared draft, editing and adding or deleting the accomplishment items and rating each Research Focus Area (RFA) on the basis of those items. The full SScAC will discuss the subcommittee-edited narratives and RFA ratings, approve or amend the final selection of narrative items, concur with or adjust the RFA-level ratings, and assign ratings at the Science Objective level. After the SScAC meeting, the staff will edit the narratives to make the item descriptions more understandable to lay readers. The SScAC-approved version will be kept to provide an audit trail for the ratings.

The color-code ratings were defined as follows. A "blue" rating indicates science accomplishments that were surprising or otherwise exceeded expectations for this fiscal year. A "green" rating indicates that accomplishments this year reasonably achieved expectations. A "yellow" rating indicates that accomplishments fell short of expectations, but significant progress was made in some areas. A "red" rating indicates major shortfalls in scientific progress compared with previous years or reasonable expectations.

During the discussion of each RFA, the SScAC considered the strength, importance, and breadth of the listed items in supporting the rating for that RFA. Accomplishment items were prioritized and, in cases where more than 4 items were listed, the members discussed which items to eliminate in the interest of brevity. Members made suggestions for clarifying the scientific importance of supporting items, particularly for nonspecialist readers.

Origins Theme RFAs. The review was led by Dr. Spergel. RFAs 5.8.2 and 5.8.3 had been rated "green" by the OS, and the rating was accepted by SScAC after discussion. RFA 5.8.3 is to be changed to "blue" if anticipated papers on Spitzer results are published before October. The members discussed the procedure for wording items for the lay audience version, which was viewed as an essential part of communicating space science value to decision makers. RFA 5.8.4 was changed from "green" to "blue" for the discovery of Sedna. RFA 5.8.1 will be rated either "green" or "blue," depending on whether the Hubble Ultra-Deep Field and GALEX papers are published this fiscal year. Under Objective 5.9, RFA 5.9.4 was rated as "blue" after reordering the supporting items. The consensus on RFAs 5.9.1, 5.9.2, and 5.9.3 was to rate them as "green."

SEU Theme RFAs. Dr. Kolb led the review. Both of the RFAs under Objective 5.10 were rated “green” because of Wilkinson Microwave Anisotropy Probe (WMAP) successes and data published this year. Staff will add an accomplishment item for data from the Boomerang suborbital mission. The SScAC consensus on RFA 5.10.3 was to rate it as “blue.” After discussion and rearrangement of accomplishment items for some RFAs, the RFAs under Objectives 5.11 and 5.12 were rated as “green.” There was further discussion of ways to strengthen and clarify the importance of the accomplishment items to communicate them to a nonspecialist audience.

GPRA 2: SECAS Presentation and Discussion

Dr. Clemmons led the discussion of SEC theme RFAs. The strong event on the Sun in October 2003 had numerous significant results, for which the entire system of SEC satellites was used to gather coordinated observations. For RFA 1.3.1, two accomplishment items were dropped for length and only the four most important were kept. The SScAC discussed and agreed on changes to the accomplishment items for RFA 1.3.3, with its rating changed from “green” to “blue.” Wording improvements were discussed for each of the RFAs under Objective 5.6, and the SScAC agreed that the accomplishment items should be reworked into broader statements on comparative magnetospheres, comparative atmospheres, and Earth magnetosphere results.

Explorer Phasing

Dr. Paul Hertz, Explorer Program Scientist, briefed the SScAC on the phasing of Explorer missions no. 11 and 12. Swift is the 83rd mission in the Explorer Program, which began with Explorer I in 1958. Each Explorer mission is led by a principal investigator (PI), and missions are selected through an open, competitive process, with an AO released about every 18 months. Typically, 30 proposals or more are submitted in response to an AO. Explorer policies and procedures are designed to maximize science return within program constraints of a fixed budget, frequent flight opportunities, and a firm management principle of terminating projects that fail to meet development commitments. The status of Explorer missions in development was covered in the division updates. Dr. Hertz noted that several Explorers in extended missions have been ended by the Senior Review; these decisions to terminate still-operable missions reflect the cost–benefit trades in the context of a fixed budget for the entire Explorer Program.

The budget decrease included in the FY 2005 Budget Request will mean less frequent Explorer starts over the next four years. Although NASA is planning on the budget recovering after FY 2008, the reduced funding requires a trade between fewer Small Explorer (SMEX) approvals versus a delay in SMEX and Medium-class Explorer (MIDEX) launch dates. The MIDEX missions in phase A this year—Time History of Events and Macroscale Interactions during Substorms (THEMIS) and the Widefield Infrared Survey Explorer (WISE)—are not affected by the budget change, but the SMEX selection will be affected. In the latest SMEX competition, five proposals were selected to enter phase A. One mission of opportunity was selected for phase A. In response to Explorer Program funding decreases in FY 2004, there will be a downselect in November to two missions to enter phase B.

NASA had originally intended to ask the SScAC and its subcommittees for guidance on options to address current budget challenges facing the Explorer Program. But, under the legal definition of conflict of interest for Special Government Employees, which applies to the SScAC and its subcommittees, many members of each would have had a conflict of interest. NASA therefore decided that the SScAC and its subcommittees were not appropriately constituted to provide advice on this programmatic decision. NASA’s decision is to select two SMEX missions in the November 2004 downselect for phase B and to delay the next MIDEX AO by about a year, to the summer of 2005. A draft AO will probably be released in late winter or early spring 2005. The

FY 2005 budget request supports a SMEX AO every 1 to 1.5 years after the next MIDEX AO. A caveat is that the MIDEX AO date is a “no earlier than” date, and a number of program contingencies could cause it to be further delayed.

Dr. Hertz noted that, under the conflict of interest constraints, only the SScAC members with no potential conflict of interest could discuss or ask questions about the NASA decision on SMEX selections. The SScAC and Dr. Hertz discussed the funding profile from FY 2004 through FY 2009. Dr. Kolb suggested that, in light of the recent outyear funding changes to the Explorer Program, the SScAC should include in its letter a strong statement of general support for the program.

Committee Discussion

Dr. Christensen led the SScAC in listing and discussing topics the committee wanted to address with Mr. Diaz during his conference call later in the afternoon. Topics discussed included the decrease in presence of space scientists in the top level of NASA leadership and the importance of maintaining open communication with the space science communities, the future advisory committee structure for NASA space science, and how Mr. Diaz views the roadmapping process in structuring priorities for the SMD. Technology development topics raised included maintaining support for the technology requirements of future space science missions and how those technology needs would be integrated with the technology roadmapping being led by the Advanced Planning and Integration Office. Concerns were raised about JIMO mission success, how well the processes for interaction between SMD and ESMD will sustain space science priorities, and the fate of the Space Science E/PO Program in light of the reorganization. Committee members also were interested in Mr. Diaz’s view of the role of ARC relative to JPL and GSFC and his views on the role of the Astrobiology Institute in pursuing Exploration Vision goals.

Lunch Presentation on MER Science Results

During the lunch break, Dr. Michael Malin, a geomorphologist on the MER Athena Science Team, presented details of the science results from the rovers Spirit and Opportunity. During the martian winter, when the rovers receive reduced amounts of solar energy, the ability to relay data to an orbiter satellite rather than using direct-to-Earth transmission has conserved a great deal of energy and helped to maintain the rovers in operable condition. Spirit has found that the rock population on the plains differs from that in the hills. All the rocks in Gusev crater were vesicular olivine basalt, with no sign of formation under flowing or standing water. The thin dust covering everything explains the limitations in using remote sensing from orbiters to detect details of mineralogy. In Eagle crater on Meridiani Planum, Opportunity found layered sedimentary rock because bedrock was not far below the surface. Dr. Malin thought the sulfur content of the Meridiani bedrock might be the most important result from MER thus far. He discussed the geomorphologic differences found in the different craters Opportunity has visited and gave his current view of how Meridiani Planum may have formed as a sedimentary basin. This view raises a set of new questions about the role of water in shaping the surface of Mars.

GPRA Part 3: SSES Results

Dr. Lunine led the discussion of SSES theme RFAs. The SSES had assigned “blue” ratings only to the MER results. The SScAC reviewed and approved the SSES ratings for the RFAs under Objective 1.4. After discussion, the rating of RFAs 5.1.4 and 5.2.3 were changed from “yellow” to “green,” with addition of some accomplishment items. Discussion of Objective 5.4 was interrupted by the conference call with Mr. Diaz (see next heading).

After the conference call, discussion of the Science Objectives assigned to the SSES continued. Several accomplishment items under Objective 5.4 were changed to emphasize science results rather than programmatic accomplishments, and the “green” rating on Objective 5.4 was kept. Additional accomplishment items were added to RFAs 5.5.1 and 5.5.2. After discussion, the ratings of these RFAs was changed from “green” to “blue,” as was the rating for Objective 5.5.

At Dr. Illingworth’s suggestion, the SScAC reconsidered the evaluation of Objective 5.8. After changes to RFA 5.8.1, the rating of Objective 5.8 was changed from “green” to “blue.”

Conversation with Mr. Diaz about the NASA Reorganization

Mr. Alphonso V. Diaz, the incoming Associate Administrator for the SMD, spoke with the SScAC by telephone about the NASA transformation and his plans for organizing the mission directorate. After considering a division structure based on the themes of origins, evolution, and fate suggested by the Aldridge Commission, he decided to use a structure with three mission-related divisions: Sun–Earth System, Solar System, and Universe. Mr. Diaz explained the roles of the mission support and mission enabling divisions within the SMD. A staff unit called Exploration Science and Mission Integration will coordinate with the other mission directorates. The addition of ARC to the science-centered NASA Centers (GSFC and JPL) is an interim solution. Although ARC will continue to support mission goals that cross the mission directorates, science seemed to be the dominant area. Mr. Diaz expects a transition to a single Headquarters lead with responsibility for institutional management of all the NASA Centers.

Mr. Diaz next discussed his organization principles. He hopes to retain some of the unique aspects of the former Space Science Enterprise and Earth Science Enterprise in the new organization. His aims include protecting the successful completion of ongoing activities and minimizing disruption or dislocation of employees and positions. The process of transformation, which is more than just a reorganization, is meant to be methodical, deliberate, and inclusive. Beyond the personnel assignments and performance plan changes that will be needed, transformation will require community involvement. NASA advisory committees and the National Academies will be involved, but plans for that involvement are still evolving.

In response to Dr. Christensen’s question on the relation of the Exploration Vision to science, Mr. Diaz said he agreed with the Aldridge Commission’s view that science is both enabling for and potentially benefited by exploration activities. Dr. Larry Smarr, chair of the Earth System Science and Applications Advisory Committee (ESSAAC), who had joined the meeting, commended Mr. Diaz and Dr. Asrar for helping to move the vision toward an Earth and Space Exploration Initiative. This helps in correcting the perception that exploring the Earth was not included in the Exploration Initiative. Dr. Asrar, participating by telephone with Mr. Diaz, agreed that there should be general recognition of the role of the Earth system as part of solar system exploration. Mr. Diaz added that Dr. Asrar, as the chief of exploration science on the NASA Strategic Planning Council, will provide a strong voice for science at the highest levels in the Agency. As to the balance between science questions and other objectives in mission planning and selection, Mr. Diaz said there will be a mix of science to support exploration activities. Once the exploration missions are implemented, there will be opportunities for science activities as well.

In response to a question about self-organizing strategic planning activities within science communities, Mr. Diaz said that he is used to NASA relying on the self-organizing activities of the science community to help inform the Agency about future directions for research. He cited the strong tradition within the NASA Office of Space Science of working with the National Academies through studies such as the Space Studies Board’s Decadal Surveys. He anticipates that a similar kind of strategic planning approach will be used for Earth science in SMD

programs. He also wants to consult with the science community on suggestions from outside the community that may involve changes from past directions. Dr. Asrar agreed that the NASA strategic plans formulated by the NASA enterprises with input from their science communities are the blueprints for future NASA plans and priorities. Dr. Asrar also responded to a question on how to work with the synergies and the differences between research on the Earth and on other planets. Study of the Sun-Earth system is the area where closer cooperation and interaction is likely to be most productive, he said, with comparative planetology being another area of synergy. There are also opportunities in the Universe Division to consider what signatures should be used to identify and characterize life and Earthlike planets. With respect to Earth science objectives, Dr. Asrar said that NASA has given the Earth science community the opportunity to define goals and objectives in response to the question: “What are unique contributions that NASA can make to understanding the planet Earth?”

In response to a question about space science E/PO, Mr. Diaz credited Jeff Rosendahl and expressed his commitment to continuing the emphasis on benefits to the educational community. He recognizes that NASA space science and Earth science have made considerable financial and human resource investments in education activities. On the fate of the current advisory committee structure, Mr. Diaz said he is inclined to maintain the involvement of those already participating and to pursue a dialogue on how to restructure for the long term. With respect to input specifically on space science, he believes that Dr. Asrar can provide leadership in the organization and advise him on both Earth and space science.

With respect to rumors about the transfer of large portions of the NASA Earth science mission to NOAA, Mr. Diaz said he does not hear anything about NOAA taking over anything for which NASA currently has responsibility. There is interest in NASA and NOAA working together on improving the transition from developing new capabilities to the operational context. On the question of improving the technology roadmapping to support science mission needs, Mr. Diaz said that the Associate Deputy Administrator for Systems Integration and the Director of Advanced Planning are working on technology roadmaps, which will be assigned to the mission directorates for implementation. These roadmaps will include more than just the technologies needed to enable exploration missions. With respect to JIMO specifically, more consideration is needed. Mr. Diaz expects there will be both crosscutting and mission-specific technology programs within SMD, but discussions about technology programs are not yet underway. Mr. Diaz addressed several questions on information technology infrastructure to support sensor web approaches to Earth observing systems and for making data from space-based systems more accessible to user communities.

When asked if science is a driving element in structuring SMD activities relative to exploration, or simply one that enables and benefits from exploration, Mr. Diaz said one ought not to expect that science will be the only guiding principle for what NASA does. Science should enable exploration and benefit from it, but science is not the only motivation for exploration. In the history of human exploration, pursuit of knowledge is sometimes a motivation, but there are other motives. Mr. Diaz thinks there are other motivations in addition to science in exploring the Moon and Mars. With respect to some areas of Earth science that the Earth Science Enterprise has been pursuing, Mr. Diaz said that the Exploration initiative does not mean that everything in NASA science has to either enable or benefit from exploration. There is science that is important in its own right. But there will be issues about how priorities are structured to take advantage of Exploration initiative opportunities. In response to a question on the role of the NASA Astrobiology Institute, Mr. Diaz said he would be talking further with the program manager, but he has no thought at present that the program should be dramatically different than it is now. On

the Explorer Program, Mr. Diaz said it will be left as it is until there is time to review the processes and mission management elements.

After several additional questions on interaction between SMD leadership and the science communities, Dr. Christensen and Dr. Smarr expressed their hope that Mr. Diaz would plan to brief the two advisory committees when they next meet. Mr. Diaz said that he will try to attend the meetings of both the space science and Earth science advisory committees. Dr. Christensen and Dr. Smarr thanked Mr. Diaz and Dr. Asrar for their participation in the discussion.

Education and Public Outreach Update

Dr. Philip Sakimoto, Acting Director, Space Science E/PO, described the status and plans for the Space Science E/PO Program. During its first three years, the Minority University and College Education and Research Partnership Initiative (MUCERPI) has been active in developing research collaborations at minority universities, expanding space science in academic programs, and fostering outreach to teachers, precollege students, and the public. The latest round of awards in January 2004 selected 16 minority institutions, with more than 50 space science institutions involved as partners. A workshop to foster broader participation in NASA space science missions and research programs by minority scientists was held in Chicago in June 2004. It focused on engaging minority scientists and scientists at minority universities as space science investigators. Next steps in this effort are under consideration.

Dr. Sakimoto presented summary statistics illustrating the extent of the FY 2003 Space Science E/PO program. There were 40 E/PO activities, which held more than 5,000 discrete E/PO events. Contributors included over 1,300 scientists, technologists, and support staff affiliated with 115 Office of Space Science missions and programs. More than 2,400 institutions participated as host sites for exhibits and events. Dr. Sakimoto said that both the quality and number of proposals for small grant supplements for E/PO is increasing.

The Space Science E/PO program has been evaluated by an SScAC E/PO Task Force and by external evaluators through the Lesley University Program Evaluation and Research Group. In response to the recommendations from these evaluations, the E/PO program is developing a Space Science Curriculum Framework and engaging in activities targeted to professional development of E/PO specialists. E/PO objectives and activities are now embedded in every space science mission. Funding for the program comes from the Office of Space Science budget and its programs and projects, not from the NASA Education Enterprise. Members discussed E/PO activities targeted to teacher preservice training and to others who are not aiming to be scientists. The implementation plan for Space Science E/PO does not currently include undergraduate science majors. The E/PO Support Network is a response to the SScAC Task Force's recommendation for coherence and points of access. NASA has established an Education Advisory Committee, which has met twice. Dr. Sakimoto suggested that there should be more structured interaction between the SScAC and the Education Advisory Committee.

In response to a question on how the SScAC meeting could help, Dr. Sakimoto said that, with the transformation occurring, it is important to emphasize the SScAC's interest in E/PO. At present, E/PO issues are beyond the horizon, but they will be coming up. SScAC members suggested that space scientists would be more likely to participate in E/PO programs under the Intergovernmental Personnel Act if they were assigned within the Science Directorate, rather than in the Office of Education. The SScAC discussed the content of a recommendation on E/PO activities in SMD, which is to be included in the SScAC letter to the Associate Administrator for Science.

Sounding Rocket Program Status and One-Year Plan

Dr. Richard Fisher described the consequences of the President's FY 2005 Budget Request on the sounding rocket program and the plan for modifying the program in response to the changes in budget outlook. The implementation scenario developed in May 2004 by the Sounding Rocket Program Office (SRPO) includes canceling the FY 2005 mobile campaign scheduled for Hawaii and changing the launch vehicle mix from 12 Black Brant rockets and 5 surplus-class launch vehicles to 5 Brant-class and 12 surplus-class vehicles. Dr. Fisher summarized the program cost items budgeted for FY 2004 through FY 2009 and the financial and science considerations related to closing or maintaining launch sites. He said that now is the time to consider the needs for the future using a zero-based approach, incorporate those needs into the space science roadmapping activities, and then examine the gap between program needs and the program's capability to support them.

The SScAC discussed the questions posed by Dr. Fisher. The relationship and differences between the sounding rocket program and the balloon program were raised. Dr. Hertz noted that the balloon program is developing a science roadmap to identify the compelling opportunities for science to be done with balloons (e.g., ultralong duration balloons, long duration balloons, conventional flights, and Antarctic flights). Dr. Clemmons said that the SEC roadmap will include sounding rocket science objectives. The SScAC discussed how the situation for the sounding rocket program should be addressed in the committee's letter.

Discussion

Dr. Christensen led the SScAC in drawing up a list of topics for the letter to the Associate Administrator. After brief discussion of points to be made on a topic, one or more members were assigned to draft text to be reviewed and revised during the Friday session. Writing assignments were made on the sounding rocket program, E/PO impacts and future direction, technology development issues related to the loss of Office of Aerospace Technology programs, the launch vehicle situation for JWST, the vulnerability of the outer planets program to JIMO schedule delays, divisions in JIMO responsibilities, the Explorer Program, future of the Planetary Data System, the replan of TPF as two missions, and several organizational issues related to the NASA transformation. Dr. Christensen then adjourned the meeting until the following morning.

*Friday, July 30, 2004*Discussion of Draft Letter Text

Dr. Christensen led the SScAC in discussing the letter items drafted by the members. The review and revision of draft text continued until Dr. Weiler arrived.

Discussion with the Associate Administrator

The SScAC discussion with Dr. Weiler began with Dr. Christensen expressing the committee's appreciation of Dr. Weiler's participation in the meeting and his involvement with the space science community over the years. The first topics discussed were SScAC's concerns with the linkage of science objectives and mission needs with exploration goals and the Agency's level 0 requirements. Dr. Weiler and the members discussed appropriate wording for expressing the consensus of the SScAC on the importance of science for guiding, sustaining, and advancing space exploration.

Other topics discussed were concerns about potential delays in JIMO and the consequences for outer solar system science missions, technology development programs within the SMD to support the needs of science missions, the JWST launch vehicle issue, the role of space science E/PO in the new NASA and SMD structure, and the follow-on advisory structure for SMD. The

constraints and timing on a robotic servicing mission to HST and SScAC's strong support for the Explorer Program were discussed. In his closing remarks, Dr. Weiler thanked the members for their involvement and commitment to helping NASA and their science communities.

Dr. Christensen adjourned the SScAC meeting at 11:00 a.m.

AGENDA

SPACE SCIENCE ADVISORY COMMITTEE

July 28–30, 2004
Shelter Point Hotel and Marina
1551 Island Drive
San Diego, California

Wednesday, July 28

Noon	Lunch	
1:00 p.m.	AA Status Report with Q&A	E. Weiler
2:00 p.m.	Division Reports	A. Kinney, O. Figueroa, R. Fisher
3:30 p.m.	Break	
3:45 p.m.	Subcommittee Reports (excluding GPRA and Explorer Phasing)	D. Spergel, E. Kolb, M. Thomsen, J. Lunine
7:00 p.m.	Committee Dinner	

Thursday, July 29

8:30 a.m.	GPRA 1: SEUS and OS Presentations and Discussion	E. Kolb, D. Spergel, A. Christensen
10:00 a.m.	Break	
10:15 a.m.	GPRA 2: SECAS Presentation and Discussion	J. Clemmons, A. Christensen
11:00 a.m.	Explorer Phasing	P. Hertz
11:30 a.m.	Sounding Rocket Program Status and One-Year Plan	R. Fisher
Noon	Lunch with Science Talk: MER Results	Michael Malin
1:00 p.m.	GPRA 3: SSES Presentation and Discussion	J. Lunine
2:00 p.m.	Conversation about Reorganization	A. Diaz
4:00 p.m.	Break	
4:15 p.m.	Education and Public Outreach Update	P. Sakimoto
4:45 p.m.	Committee Discussion	A. Christensen

Friday, July 30

8:30 a.m.	Letter Writing	A. Christensen
9:00 a.m.	Conversation with AA	A. Christensen, E. Weiler
11:00 a.m.		Adjourn

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MEMBERSHIP LIST
July, 2004

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American Institute of Physics

Dr. David W. Deamer
University of California, Santa Cruz

Dr. Michelle F. Thomsen
Los Alamos National Laboratory

Dr. Stephen A. Fuselier
Lockheed Martin Advanced Technology
Center

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Dr. Andrew C. Klein
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Fermi National Accelerator Laboratory

Mr. Martin P. Kress
Battelle Memorial Institute

Dr. Jonathan I. Lunine
The University of Arizona

Dr. Jeremy R. Mould
National Optical Astronomy Observatory

Dr. John F. Mustard
Brown University

Dr. David N. Spergel
Princeton University

SPACE SCIENCE ADVISORY COMMITTEE

July 28–30, 2004

Shelter Point Hotel and Marina

San Diego, California

MEETING ATTENDEES*Committee Members:*

Christensen, Andrew, *Chair*
 Allen, Marc, *Executive Secretary*
 Clemmons, James

Deamer, David
 Fuselier, Stephen
 Grindlay, Jonathan
 Hammel, Heidi
 Harrison, Fiona
 Illingworth, Garth
 Karpen, Judith
 Klein, Andrew
 Kolb, Edward “Rocky”
 Kress, Martin
 Lunine, Jonathan
 Mould, Jeremy
 Mustard, John
 Spergel, David
 Stith, James
 Werner, Michael

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 Michelle Thomsen)
 University of California Santa Cruz
 Lockheed Martin
 Harvard-Smithsonian Center for Astrophysics
 Space Science Institute
 California Institute of Technology
 University of California Santa Cruz
 Naval Research Laboratory
 Oregon State University
 Fermi National Accelerator Laboratory
 Battelle Memorial Institute
 University of Arizona
 National Optical Astronomy Observatory
 Brown University
 Princeton University
 American Institute of Physics (Pending)
 NASA/JPL

NASA Attendees:

Bergstralh, Jay
 Breckrinridge, Jim
 Crain, Philippe
 Devirian, Michael
 Feeley, T. Jens
 Fisher, Richard
 Gay, Charles
 Hasan, Hashima
 Hertz, Paul
 Jones, W. Vernon
 Kinney, Anne
 Knopf, William
 Meadows, Victoria
 Montemerlo, Mel
 Moore, Michael
 Moore, Thomas
 Nelson, Robert M.
 Norris, Marian

NASA Headquarters
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 NASA Headquarters
 NASA/GSFC
 NASA/JPL
 NASA Headquarters

Penny, Alan
NASA Attendees—continued

NASA/ARC

Rabin, Doug
Riegler, Guenter
Sakimoto, Phil
Salamon, Michael
Schober, Wayne
Smith, Eric
Spann, Jim
Thronson, Harley
Varsi, Giulio
Vondrak, Richard
White, Nicholas
Wiseman, Jennifer
Woods, Dan
Yorke, Harold
Zellot, Rex

NASA/GSFC
NASA/ARC
NASA Headquarters
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NASA/GSFC
NASA/GSFC
NASA Headquarters
NASA Headquarters
NASA/JPL
NASA Headquarters

Other Attendees:

Beres, Kathleen
Clark, Chris
Danner, Rolf
Di Biasi, Lamont
Eckardt, Derrick
Helou, George
Hogan, Craig
Katt, Robert
Kaplin, John
Leshin, Laurie
Lester, Dan
Malay, Jon
Margon, Bruce
Melin, Mike
Meyer, Michael R.
Minter, Bernard
Morse, Jon
Purcell, William
Purdy, William
Sumler, Carole
Swan, Larry
Wright, Edward

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General Dynamics
NGST
L. Di Biasi Assoc., Southwest Research Institute
Boeing
California Institute of Technology
University of Washington
INFONETIC
General Dynamics–Spectrum Astro
Arizona State University
University of Texas
Lockheed Martin
Space Telescope Science Institute
MSSS
University of Arizona
University of California San Diego/SIO
Arizona State University
Ball Aerospace
Ball Aerospace
self
University of California San Diego
University of California Los Angeles

SPACE SCIENCE ADVISORY COMMITTEE

July 28–30, 2004

Shelter Point Hotel and Marina

San Diego, California

LIST OF PRESENTATION MATERIAL¹

- 1) Edward J. Weiler, Office of Space Science, *Space Science Update*. Presented to the Space Science Advisory Committee. July 2004.
- 2) Dr. Anne L. Kinney, Director, Astronomy and Physics Division, Office of Space Science, NASA. Astronomy and Physics Division Overview. July 26, 2004.
- 3) Orlando Figueroa, Director, Solar System Exploration Division, Office of Space Science, NASA. *Solar System Exploration*. July 2004.
- 4) Richard Fisher, Director, Sun-Earth Connection Division, *Sounding Rocket Operations: FY 2005 President's Budget*. Report to SECAS/SScAC, July 2004.
- 5) *Annual Report. Astronomy and Astrophysics Advisory Committee*. March 16, 2003–March 15, 2004.
- 6) Paul Hertz and Hashima Hasan, Explorer Program Scientists, Office of Space Science, *Explorer Program: Presentation to Space Science Advisory Committee*.
- 7) Philip J. Sakimoto, Acting Director, Space Science Education and Public Outreach, *NASA's Space Science Education and Public Outreach (E/PO) Program: Inspiring the Next Generation of Explorers*. Report to SScAC, July 29, 2004.
- 8) Al Diaz, *Science Mission Directorate*. Presented to the Space Science Advisory Committee, July 2004.

¹ Presentation and other materials distributed at the meeting are on file at NASA Headquarters, Science Mission Directorate, Washington, DC 20546.

**Letter from the Chair, Astronomical Search for Origins Subcommittee,
to the Chair, Space Science Advisory Committee**

Dear Andy:

The Origins Subcommittee met in San Diego on July 26-28, 2004. We met in joint session with the SEUS committee during the afternoon of July 26 and the mornings of July 27 and July 28.

Anne Kinney reported on the overall health of the Astronomy program to our joint session. NASA astronomy program is in the midst of its golden age. With regular access to space for innovative missions, NASA missions are producing superb science that reshapes our view of the universe, alters our understanding of fundamental physics and excites the broad public. The Origins Committee developed our recommendations for the GPRA report that we have presented to the SScAC. These recommendations reflect the vibrancy of the Origins Program.

Eric Smith and Marc Allen discussed the implications of NASA restructuring for the Origins program and the Origins Committee roadmapping efforts. The Origins roadmaps will be closely tied to and potentially merged with the SEUS roadmap.

Michael Moore and Anne Kinney described plans to maximize the science return from Hubble Space Telescope over the next few years including plans to operate the telescope in 2-gyro mode. NASA is now planning to service HST with a robotic servicing mission that will maintain its operability and enhance its capabilities through the addition of new instruments. **We encourage NASA to design the refurbishment mission so that the scientific productivity of HST is maximized.**

Mel Montemerlo reported on his efforts to identify long-term technology needs of the Origins science program. The Aldridge report strongly recommended investing in the NASA long-term technology needs. The committee is concerned that with the disappearance of Code R and Code T focusing on developing technologies for the Moon-Mars program, the agency is not investing in the development of the mid-TRL technologies needed for Origins Science. We suspect that this problem is common to all of Space and Earth Science. **We recommend that SScAC and its successor committee consider this issue.**

John Mather reported on continued progress in developing JWST, one of the key flagship missions for the Origins program and the top rated program in the current decadal survey. Mather reported that there have been significant delays in obtaining approval for the use of the Ariane. Further delay may begin to have schedule impact. If use of the Ariane is not approved, then this will have a major budgetary impact on this vital program. **The Origins Committee recommends that the SScAC urge NASA to work with other agencies to accelerate the launch approval process.**

Paul Hertz reported on the current status of the Explorer program. Headquarters plans to select 2 SMEXs in November 2004 and then issue an AO in November 2005. **As the Explorer program has been one of NASA's most cost effective, we hope that the program will be restored to full funding so that there are no more lost launch opportunities.**

TPF and SIM

The Origins Committee received an update on the Navigator program from Michael Devirian and on two of its key components, SIM and TPF, from Michael Shao and Chas Beichman. Michael Shao reported that SIM continues to make progress towards meeting all of its demanding technology goals.

Anne Kinney and Chas Beichman described plans to restructure the TPF program. The rapid progress in developing laboratory technologies needed for coronagraphy has given NASA the capability of detecting Earthlike planets around nearby stars within the next decade. The new plan for the TPF program is to launch two missions: TPF-C, a 3 x 6 meter coronagraphic optical telescope, and TPF-I, an infrared interferometric mission. TPF-C will be launched first and will also have significant capabilities for astronomical imaging. TPF-I is potentially a collaborative mission with the Europeans. The combination of TPF-C and TPF-I will be able to characterize the atmospheric properties of nearby Earth-like planets and infer the presence of life.

The Origins Committee is enthusiastic about achieving the goals of TPF, detecting and characterizing Earth-like planets, and endorses the proposed revision in the plan. We strongly recommend that TPF-C include two auxiliary science instruments to maximize science return. We strongly endorse competing all possible components of TPF-C to encourage a broad range of capabilities. TPF-I will be the next step in the roadmap beyond TPF-C.

Anne Kinney reported on plans to compete the TPF science center in 2006. The Origins Committee applauds the decision to compete this center and encourages NASA to select all of its science centers through competitive processes.

SOFIA

Tom Greene, members of the SOFIA science working group, and the SOFIA science team reported on the current status of the SOFIA mission. The OS is enthusiastic about SOFIA's unique range of instruments that will result in exciting Origins science in under-explored portions of the electro-magnetic spectrum. The 25-year baseline of SOFIA allows for instrumentation upgrades as technology advances. Because of various development delays and unanticipated cost increases (due to a combination of changing FAA certification rules, fuel and salary run-ups, as well as full-cost accounting), SOFIA is over budget and as a consequence does not have the funds needed to operate the mission as a facility-class telescope. The SOFIA science community is eager to operate in this more productive mode rather than as an observatory with only PI-class instruments. In particular this means having the ability to support observers through personnel at the SOFIA science center, documentation, and a data archive, none of which were in the original contracts.

The Origins Committee recommends beginning SOFIA operation as soon as possible. We do not endorse request for supplemental '05 funding but await results of NASA review and will evaluate SOFIA's role as part of roadmapping process

NASA Restructuring

Ed Weiler presented a report on the status of Space Science and NASA plans for reorganization. The Origins Committee warmly thanks Ed Weiler for his leadership as Associate Administrator for Space Science and looks forward to continuing to work with him as he takes on his new

responsibilities as head of Goddard Space Flight Center. We also look forward to working with Al Diaz, the new head of the Science Directorate.

As part of NASA restructuring, the Origins Committee will be merged with the SEUS committee. We look forward to working with our SEUS colleagues in supporting the new Universe Division.

Sincerely yours,

David Spergel for the Astronomical Origins Committee

**Letter from the Chair, Sun–Earth Connection Subcommittee,
to the Chair, Space Science Advisory Committee**



International, Space, and Response Technologies Division

Space and Atmospheric Sciences (ISR-1)

P.O. Box 1663 – MS D466

Los Alamos, New Mexico 87545

(505) 667-1210/Fax (505) 665-7395

August 25, 2004

ISR-1-04-100

Dr. Andrew Christensen
Northrop Grumman Space Technology
One Space Park, R9-1914
Redondo Beach, CA 90278

Dear Andy,

The Sun-Earth Connections Subcommittee met in San Diego on July 26-28. Because of my unanticipated absence, SECAS member Jim Clemmons (chair of the Geospace MOWG) served as acting chair. With invaluable assistance from Barbara Giles, Jim did a great job leading the meeting. A copy of the agenda is attached to this letter.

One of the important activities of the meeting involved the review, revision, and acceptance of the SEC summary of accomplishments for this year's GPRA review. The committee was very pleased with the breadth and depth of these accomplishments, and we congratulate NASA headquarters and the science community on an exciting, productive year.

Another important activity was a discussion of this year's roadmapping process and the consideration of guidance the committee will give the SEC roadmap committee. We are pleased that Todd Hoeksema will chair the roadmap committee, with co-chair Tom Moore.

The committee heard an update on the Explorer program status and would like to express its appreciation for the way in which the Explorer program has responded to its resource shortfall issues. SEC relies heavily on this program for achievement of strategic goals in a timely manner, so the ability of the Explorer program personnel to minimize the amount of disruption to the program is especially valuable. The committee offers its gratitude to those instrumental in this effort, especially Dr. Paul Hertz and Mr. Chuck Gay.

A highlight of our meeting was a joint lunch session with SSES, during which we addressed a number of topics of mutual interest. Recognition of the overlapping interests of our two communities gave rise to one of our findings, namely that we jointly explore research and mission opportunities that promote synergistic planetary and space research investigations. Another outcome of the discussions was an agreement to exchange representatives on our respective roadmap committees. I am hopeful that such joint sessions can become a regular feature of future committee meetings.

In our continuing effort to explore the interrelationship of SEC science and the Exploration Vision, part of our discussion focused on the importance of understanding at a predictive level the space environment to which human space travelers must be exposed. One of our findings is thus a recommendation that such a predictive capability be recognized as a high-order requirement of the Exploration program.

Our full set of findings is attached.

One final note: Our committee wishes to express our gratitude to Ed Weiler for his unstinting and effective service to our nation in the cause of scientific discovery and understanding. His dedication to the fundamental importance of the highest-quality science as the foundation and motivation of a successful space research program are deeply appreciated, and we wish him well in the new challenges he faces at Goddard Space Flight Center. We also extend our welcome to Al Diaz and our best wishes for a strong and productive partnership in the execution of NASA's exciting science program.

Best regards,

Michelle F. Thomsen
SECAS chair

cc Dr. Richard Fisher

attachments

SECAS Findings from 26-28 July 2004 Meeting
Agenda for 26-28 July 2004 SECAS Meeting

Summary of SECAS Findings, 26-28 July 2004

1. Need for an agency-level requirement to characterize and understand the space environment

Issue: An agency level requirement is needed to characterize and understand the dynamic space environment in which robotic and human missions will be immersed. This dynamic space environment is often a significant source of variability in planetary environments.

Background: The Exploration Vision has elevated the significance of the science of Solar System Connections. Understanding and being able to predict the environment of space and its interaction with planetary bodies is needed for deep space travel of robotic and human missions. There are unique areas of expertise regarding space weather and therefore unique contributions that only this community can make to the exploration effort.

Recommendation: We recommend that an agency Level-0 requirement be established for an end-to-end predictive capability for solar system environmental conditions based on observations, theory, and modeling.

2. Sounding rocket program

Issue: The projected sounding rocket program budget through FY09 requires a major scaling back of the program. The Sounding Rocket Program Office (SRPO) has submitted a proposal for this reduction, which does not meet the needs of SEC.

Background: The projected budget for the sounding rocket program is flat through FY09, falling 35% below the previously expected budget. This eliminates new projects: the advanced pointing system and high performance rocket development. It greatly reduces acquisition of replacement rocket motors. There will be insufficient money to support some present launch sites. To meet the shortfall, the SRPO has proposed to stop using White Sands and mobile launch sites, to develop water-recovery capability at Wallops Island, and to reduce high performance launches so that the mix of launches is predominantly surplus, low performance rockets with 75% fewer Black Brant class vehicle launches. The majority of SEC launches use Black Brant class vehicles, many of which are launched at White Sands and difficult to adapt to saltwater wet recovery.

Recommendation: Due to serious resource difficulties in the LCAS (Low-Cost Access to Space) Program, SECAS endorses the SEC plan to conduct a zero-based review of the program. In particular, SECAS reaffirms the importance of the SEC launch vehicle and launch rate needs. Any plan must ensure dry recovery for recoverable payloads.

3. Coordination of planetary and solar system connections investigations

Issue: There is no programmatic emphasis or explicit opportunity for collaboration between the planetary and the solar system connections communities.

Background: Understanding the connections within the solar system between solar variability, interplanetary space, and planets is necessary to meet exploration goals. Currently there are separate traditional opportunities to investigate planetary bodies or the connection between the variability of the sun and the magnetized plasma environment around planet Earth. There is a lack of opportunity and emphasis to meld space physics and planetary science in a mission to investigate the interrelationship between planets and the solar driven environment of space in which they are embedded.

Recommendation: We recommend that the divisions of Planetary and Solar System Connections jointly explore methods through research and mission opportunities that promote synergistic planetary and space research investigations.

4. *Scope of theory effort*

Issue: A fundamental theoretical understanding of the information gathered through NASA missions is a prime goal of the space science enterprise. The SSP Decadal Survey Report recommends that the scope of the theory effort be broadened and strengthened to better engage space science activities. Their recommendations provide opportunities for inter- and intra-agency support, and collaborative efforts engaging solar systems connections, Earth and Planetary Science.

Background: SR&T, mission theory programs, some elements of GI programs, and notably the SECTP "Theory Program" provide support for theoretical study, at various degrees of association with space datasets. The Theory Program in particular originated with the goals of supporting and maintaining "critical mass" efforts in challenging space physics problems, with funding stable enough, in the original implementations of the program, to evolve new career level positions in the science community. Currently, there is need for an augmentation of theory and modeling support for large cross-cutting efforts, the study of complex systems, nonlinear and/or cross scale couplings, non-deterministic systems and the development of end-to-end predictive capabilities that will be required for future human and robotic exploration. These topics were embraced by the SSP Survey, which recommended a program called the "Coupling Complexity Initiative".

Recommendation: SECAS recommends that activities be initiated to design and implement a cross-cutting, inter- and intra agency theory and modeling program along the lines of the Survey's Coupling Complexity Initiative to support the evolving science direction of solar system connections.

5. *EPO at post-secondary levels*

Issue: A vital and vibrant workforce comprised of young scientists and engineers is necessary for the future of the Solar System Connections community.

Background: The current emphasis of NASA's EPO program is on grades K-14. There is an apparent lack of EPO emphasis on advanced placement programs and the graduate and undergraduate levels that could serve as a mechanism to attract students to space science at the time in their lives they are making career decisions. In addition, there is no emphasis for EPO proposals to target these students.

Recommendation: The SECAS believes it would be a wise and profitable investment for the agency to use the NASA EPO program to impact more advanced levels of education to attract students to space science. In order to better understand this issue, we request that a presentation be made at the next SECAS meeting that explains the current efforts and future plans of the NASA EPO program to specifically impact advanced placement programs and graduate and undergraduate students.

6. *System science emphasis for senior review*

Issue: Guidance has been requested for developing criteria in the senior review for evaluating operating missions based on their value as elements in a distributed integrated sun-heliosphere-planetary system observatory.

Background: The Sun-Earth and heliospheric interaction form a complex dynamical system in which close couplings and feedbacks can change the zeroth-order response to solar eruptions [NASA SEC Roadmap 2002; *The Sun to Earth—and Beyond: A Decadal Research Strategy in Solar and Space Physics*, NAS, 2003]. This complexity poses formidable challenges to scientific understanding and to the range of useful prediction. Systems issues are at the cutting edge of space science and are the basis for the complexity initiative called out in the NRC Decadal survey. System science is also at the core of the "Living with a Star" program and is crucial for the understanding of the space environment that is needed for the Exploration Initiative. The immediate need is to provide a nationally focused capability to investigate the sun-earth interaction as a complex natural system. The best means to attack this problem is by synthesizing observations from the current fleet of operating satellites into a distributed sun-heliosphere-planetary system observatory. The senior review of operating missions is a strategic vehicle for crystallizing collaborations between operating missions to focus and enhance a process which is already underway as a result of grass roots efforts in the community.

Recommendation: SECAS recommends that statements in the call for proposals for extended missions solicit the best mission science in each case but, in addition, multi-mission studies that clarify coupling and feedbacks underlying the solar, geospace, heliospheric system responses.

7. Draft AO for LWS

Issue: The community of potential respondents to the impending LWS AO would benefit from the early release of information likely to be present in the released AO. Such information would allow teams to form and begin advance work, a process that is likely to result in higher-quality proposals.

Background: The community has indicated that past experience with draft AOs has been positive. They appreciate not only the ability to comment before the full AO is released, but also benefit from having information on likely release date, proposal due date, mission timeline, cost caps, and mission scenario (PI, instrument suite, individual instrument).

Recommendation: The committee urges the LWS program to find a way to release information likely to be present in the finished AO. A draft AO would satisfy this request, as would a less formal notice of intent.

AGENDA - SECAS – JULY 26-28, 2004
Shelter Pointe Hotel and Marina, 1551 Island Drive
SHELTER ISLAND, SAN DIEGO, CALIFORNIA 92106
(800) 566-2524

MONDAY, 26 JULY 2004

0815	Meeting Room Open, Coffee	
0830	Welcome	Michelle Thomsen
0840	E/PO for SEC Roadmap	Phil Sakimoto
0910	SEC Roadmap – 2006 Science Strategic Plan Schedule / OSS Guidelines Creation of charge to roadmap committee	Barbara Giles Committee
1015	Break	
1030	SEC Roadmap (continued)	Committee
1200	Group Lunch Meeting with presentation: Chris St Cyr of NASA/GSFC on “Space Weather’s Impact on Wholesale Electricity Prices” [<i>Forbes</i> and St Cyr, in press, <i>The Space Weather Journal</i>]	
1300	All Subcommittee Plenary	
1330	MOWG reports (15 min each) Geospace Solar-Heliospheric LWS	Jim Clemmons Steve Suess Jim Spann for Dan Baker
1415	Break	
1430	SEC Division Report, including Missions Update	Dick Fisher
1530	GPRA Discussion and Writing	Giles/Committee
1700	Adjourn	
1830	Group Dinner	

TUESDAY, 27 JULY 2004

0815	Meeting Room Open, Coffee	
0830	Senior Review of Operating Missions Criteria	Chuck Holmes
0900	Living with a Star issues	Dick Fisher
0930	National Academy CSSP ad hoc Committee Report	Fran Bagenal
1015	Break	
10:30	AA Presentation to joint session of SECAS/SSES	Ed Weiler
1200	Joint lunch meeting with SSES: Outer planets missions, Comparative Aeronomy, etc.	
1300	Rocket Program Status, joint session with SSES	Dick Fisher
1330	National Priorities in SEC Theory	Gary Zank
1400	Explorer Program Status	Paul Hertz
1445	Break	
1500	DSN Status and DSN Roadmapping Plans	Preston/Deutsch
1530	Lifecycle of Mission Data	Chuck Holmes
1600	Discussion and Writing Assignments	Committee
1730	Adjourn	
1900	Padres vs Giants at PETCO Park - known SECAS attendees: Fisher, Thomsen, Matthaeus, Suess, Schwadron, Clemmons, Rabin, Spann, St. Cyr, Klimchuk, Gay, Moore and Giles	

WEDNESDAY, 28 JULY 2004

0815	Meeting Room Open, Coffee	
0830	Committee Writing Time	Committee
0915	Review of Findings	Committee
1030	Break	
1045	Review Findings with Dick Fisher	Committee/Dick Fisher
1145	Committee roundtable	Committee
1200	Adjourn	

END OF MEETING

**Letter from the Chair, Structure and Evolution of the Universe Subcommittee,
to the Chair, Space Science Advisory Committee**

[To be added]

**Letter from the Chair, Solar System Exploration Subcommittee,
to the Chair, Space Science Advisory Committee**

TO: Andrew Christensen, Chair, Space Science Advisory Committee

FROM: Jonathan I. Lunine, Chair, Solar System Exploration Subcommittee

SUBJECT: Solar System Exploration Subcommittee Meeting

The Solar System Exploration Subcommittee (SSES) of the Space Science Advisory Committee (SScAC) met July 26-27, 2004 in San Diego. The purpose of this memorandum is to summarize the findings of that meeting and ask SScAC to consider them and transmit its recommendations to Mr. Orlando Figueroa, Director of the Solar System Exploration.

Mars

Topic: Subsequent to the SSES February meeting the Mars Exploration Rover Opportunity found additional compelling evidence, along multiple lines, for the past presence of standing liquid water in the Meridiani Planum Region of Mars. This water was pervasive over an area that includes all of the rover traverse to date. The discovery is of historic importance. Circumstantial evidence for water exists in rocks at the Spirit site. Both rovers have traversed several times their designed distances and continue to function, in particular through the onset of southern hemisphere winter. Because of these finds, the Mars Exploration Program is now moving on “Pathway 1: Search for Evidence of Past Life” sequence of Mars Exploration.

Issue: It is now necessary to examine the integration of the mission augmentation from the President’s Moon-Mars Initiative into the plan; for example, whether two Scouts and an additional lander in support of future human exploration of Mars should be fielded in 2011.

Recommendation: SSES will examine the 2009-2020 sequence in light of the President’s initiative and the MER discoveries this fall, and present its findings to SScAC at the latter’s fall meeting.

JIMO

Topic: JIMO funding phasing and technology development are such as to permit a launch around 2015, with an arrival at Europa in 2022 or 2023.

Issue: This arrival date pushes JIMO beyond the decadal survey horizon and introduces a potentially unprecedented hiatus in outer solar system missions. The mission is a top priority of the recent decadal survey for solar system exploration.

Recommendation: Space Science must give high priority to completing and launching JIMO under Project Prometheus, lest outer solar system exploration beyond Cassini and New Horizons effectively cease.

Discovery

Topic: With Messenger finally launched on its long voyage to Mercury, and Genesis and Stardust having completed their sample collection mission phases, SSES commends the SSED Director for his strong efforts in putting the Discovery program back on track.

Issues: (1) Kepler development is now running into problems and the confirmation review is coming up. (2) The new Discovery program office is being moved to Marshall Space Flight Center (because of external complaints about conflict of interest) and planetary expertise is lacking at Marshall. In its previous letter SSES commended the SSED Director for establishing an office at JPL.

Solution: For the good of the program, the SSES continues to support a strong policy of nonconfirmation and cancellation for missions that cannot maintain their proposed cost and schedule. SSES also will request a briefing from the Discovery Program Office at Marshall regarding their organizational and staffing plans.

New Horizons

Topic: The New Horizons (NH) mission will provide the first exploration of the outermost bodies of the solar system, particularly their volatile and organic components, and will address two of the four central themes highlighted in the 2003 Solar System Exploration Decadal Survey.

Issue: NH launch opportunity in 2006 is greatly threatened by the indefinite stand down of all activities at LANL, where RTG fuel packaging is ongoing, and by the launch vehicle certification schedule. The science hit accompanying a 2007 fallback launch is considerable – loss of a Jupiter flyby and the delay by several years of the Pluto-Charon and KBO flybys.

Solution: NASA should continue in its path to try to launch New Horizons as soon as is practical. This crisis in bringing the mission to launch readiness illustrates the need to find alternate sources for nuclear fuel packaging and other critical path items for outer solar system missions.

DSN

Topic: SSES is impressed with NASA's identification and pursuit of new technologies for increasing the data volume return, data rate, and robustness of the DSN. If the plans were implemented, data return from deep space missions could be enhanced by as much as three orders of magnitude thereby enabling more comprehensive coverage and detailed study in planetary exploration without requiring more costly communications systems on spacecraft.

Issue: Exploration goals require increased data return from future planetary missions. Furthermore, the current system is 40 years old and is a single-point failure for deep space command/control and data return.

Recommendation: SSES urges NASA to implement the system upgrades and new technology communications systems on an aggressive schedule that will minimize the chance of DSN saturation or potential catastrophic failure.

Planetary data system

Topic: SSES reviewed the status of the Planetary Data System to examine whether progress had been made on its previous recommendations. Indeed, PDS is addressing many of the committee's concerns, including the issue of peer review of data. SSES notes that PDS is a unique resource to the planetary community, and accomplishes planetary data archiving in a way that is suitable and appropriate.

Issue: The strategy for achieving the necessary level of peer review of PDS data remains unclear. A cataloging system for samples will not be implemented for Genesis at the time of its return to Earth this year. Merging of former NASA science codes raises the possibility of "one size fits all" for science archival data systems.

Recommendations: The SSES will continue to monitor PDS progress. PDS should proceed assertively with its plans for implementation of Stardust sample cataloging, which is more crucial for that particular mission. PDS should remain a separate data system and not be merged with other data systems within Space Science.

SECAS—SSES

Topic: There is a long history of space physics investigations and scientific accomplishments on planetary missions, illustrating the large overlap between the science communities represented by SSES and SECAS. At the San Diego meeting joint talks were held between SSES and SECAS to discuss areas of mutual interest and concern.

Issue: Some members of the two communities are concerned that insufficient opportunities for flight collaboration are available between space physics and solar system exploration.

Recommendation It was agreed that both groups should continue to encourage cooperation among scientists in the two areas and should be represented in each others' Roadmap committees in appropriate areas.

Sounding rockets (recommendation joint with SECAS)

Topic: The planetary science community has benefited from the sounding rocket program principally in that the program provides unique opportunities for graduate students to acquire flight experience while developing new observational capabilities. Several planetary PI's have had their roots in the sounding rocket program.

Issue: The projected sounding rocket program budget through FY09 requires a major scaling back of the program. The Sounding Rocket Program Office (SRPO) has submitted a proposal for this reduction, which does not meet the needs of the Sun-Earth Connection.

Recommendation: The planetary program is not a major user of the present sounding rocket program, but does benefit significantly from students trained in association with the program. The SSES supports the proposed plan to conduct a zero-based review of the program as a means of identifying the critical needs and seeing that they can be adequately supported. The SSES hopes that this review will help continue the opportunity for developing new flight investigation scientists, even as it fulfills critical needs in SEC science.

Finally, SSES wishes to thank Orlando Figueroa for his service as both Mars Exploration and Solar System Exploration Director, and commends him for his numerous accomplishments during this time. We will miss him and look forward to his tenure as a Deputy Associate Administrator in the Office of Space Science.

Sincerely,

Jonathan I. Lunine, Chair

**Letter from the Chair, Space Science Advisory Committee,
to the Associate Administrator, Science Mission Directorate**

**Space Science Advisory Committee (SScAC) Report
July 28 – 30, 2004
San Diego CA.**

Mr. Al Diaz
AA Science Mission Directorate
NASA
Washington D.C.

Sept 25, 2004

Dear Mr. Diaz:

The Space Science Advisory Committee met July 28-30, 2004 on Shelter Island in San Diego, CA immediately following a series of joint meetings of the Origins, Structure and Evolution of the Universe, Sun-Earth Connection and Solar System Exploration subcommittees. We were pleased with our conversations with Ed Weiler the former Associate Administrator and with you and with members of your staff. These discussions were open and far-ranging, as expected with the dramatic changes occurring within NASA and in particular the former Office of Space Science (OSS).

A major activity at our meeting was consideration of the GPRA (Government Performance Requirements Act) report for the year. As in previous years, we were impressed with the record and would like to commend the former Office of Space Science for a remarkable year of scientific accomplishments. Across the spectrum, from small missions to large observatories, from the Earth and its environs through the solar system out to the largest scales in the universe, NASA science programs have revealed stunning insights. With the launch of the Spitzer observatory, we now have a suite of remarkably powerful Great Observatories in simultaneous operation. As with Chandra and HST, Spitzer is again demonstrating how such observatories enable exploration of the universe to the delight of both scientists and the nation at large. The Mars Rovers and the scientific evidence for past standing bodies of water on the Martian surface have captivated the public's imagination and continue to return great scientific data that will be a resource for the science community for years to come. The dramatic arrival of Cassini at its destination heralded the start of the acquisition of new images and data on a majestic object in our outer system that will provide forefront scientific results. The suite of solar, heliospheric and geospace satellites have provided new understanding of the role of the Sun and heliosphere in space weather and global change as well as sparked public interest with dramatic and detailed pictures of solar eruptions and their complex effects (such as aurorae) at Earth.

The OSS Public Affairs program has been very successful at keeping NASA Space Science highly visible to the public. The public interest in many NASA missions is a continuing demonstration of the innate curiosity of the American people for insights into

our universe. Public and congressional support for space science owes much to the superb job done by the Office of Space Science to involve the media in our accomplishments, as was dramatically illustrated in Ed's report showing that 79% of NASA's Science News Metrics were based on space science.

We were encouraged that the President's Commission on Implementation of United States Space Exploration Policy (the Aldridge Commission) identified three Exploration Themes that map directly into the OSS research strategy. These go to the heart of some of the most fundamental questions: our origins, how the universe evolved and what is its fate. We hope that the agency explicitly recognizes the value to the nation of NASA's **scientific** heritage in its formulation of national high-level goals and mission objectives.

The committee wishes to thank Anne Kinney, Orlando Figueroa, Richard Fisher, Paul Hertz, and Philip Sakimoto for their high quality, informative and concise presentations. We would especially like to thank Dr. Michael Malin, President of Malin Space Science Systems, for his fascinating lunch-hour presentation on the Mars Rover scientific results.

It has been our great pleasure and honor to assist Ed Weiler during his tenure as Associate Administrator of the Office of Space Science. We have been privileged to participate in times of stress and jubilation in space science from a vantage point enjoyed by few. We wish him all the best as he leaves headquarters to serve NASA in a new role.

We look forward to supporting you in your new role and to the continued success of the space science endeavor and NASA.

Sincerely

Andrew B. Christensen
Chair, Space Science Advisory Committee

Attachments:
OS meeting report
SECAS meeting report
SEUS meeting report
SSES meeting report

Recommendations and Findings

The Role of Science in the new NASA

Space science must have a central role in the U.S. space exploration program. Clearly, the space sciences program at NASA has been extremely successful scientifically and has certainly captured the public interest. NASA's astrophysical observations, for example, are revolutionizing our concepts of the universe from black holes to dark energy while the exciting new scientific discoveries of the Mars missions are rewriting the history of the planet. Moreover, science is a prime element in the public's positive image of NASA: 9 billion web site hits during the Mars Rover operations are but one impressive measure of the extent to which NASA's scientific achievements have excited the public imagination.

The momentum of the scientific enterprise must not be lost as NASA reorganizes to meet the challenges of the Exploration Initiative. The new exploration program must recognize the value of a healthy science program and its role in sustaining public interest through such a long duration project.

Manned exploration of the moon and Mars needs a strong scientific imperative and rationale if it is to be more than expensive tourism. The present space science program is well aligned with the exploration themes highlighted by the Aldridge Commission: Origins, Evolution and Fate. Continued support of space science will invigorate, enliven and sustain the Exploration Initiative.

- 1. SScAC recommends NASA emphasize the role of science in the exploration program and apply the power of scientific discovery to inspire, guide, lead, and sustain the U.S. space exploration program, ensuring that its essential goals – including the advancement of scientific knowledge – are met.**
- 2. SScAC also recommends that the science goals related to origins, evolution, and fate of the universe including the Sun –Earth system be integrated into the highest level agency requirements and goals.**

James Webb Space Telescope (JWST)

The James Webb Space Telescope, the top priority in the Astronomy Decadal Survey and a vital tool in our efforts to explore the universe, is facing a significant financial and schedule risk. As part of its contribution to the construction and launch of JWST, ESA has agreed to provide an Ariane V launch at no cost to NASA. Unfortunately, the National Security Advisor and the Office of Science and Technology Policy (OSTP) have not yet approved this launch plan. If the plan is not approved within the next few months, there will be major risks to JWST's schedule. Moreover, if this launch plan is discarded, the cost of JWST will grow significantly and NASA's relationship with ESA will be

damaged at a time when (according to the Aldridge Commission report) international cooperation is very important for the success of the Space Exploration Initiative.

SScAC supports the efforts of the Science Mission Directorate (SMD) to pursue the interagency approval process and make this launch approval a high priority.

Outer Solar System

The outer planets program comprises two missions at this time, New Horizons and the Jupiter Icy Moons Orbiter (JIMO). The New Horizons mission will provide the first exploration of the outermost bodies of the solar system, particularly their volatile and organic components, and addresses two of the four central themes highlighted in the 2003 Planetary Decadal Survey. The launch of New Horizons in 2006 is threatened by the indefinite stand-down of all activities at Los Alamos National Laboratory, where packaging for radioisotope thermoelectric generators (RTGs) is ongoing, and by the launch vehicle certification schedule. The science lost by delaying launch until 2007 is considerable—no Jupiter flyby and several years delay of the Pluto-Charon and Kuiper Belt Object flybys. NASA is commended for its efforts to complete and develop New Horizons, against obstacles that are to some extent out of its control. **However, this crisis illustrates the need to find alternate sources for fuel packaging of RTGs and other critical path items for outer solar system missions.**

Current funding profiles and technology development for the JIMO mission will permit a launch not earlier than 2015, with an arrival at Europa in 2022 or 2023. This is close to the end of the Decadal Survey planning horizon and represents a significant slip from the plans presented last year.

SScAC recommends that NASA give high priority to completing and launching JIMO under Project Prometheus, to ensure a viable outer solar system program and that Project Prometheus technology will be available in a timely fashion for other space science missions requiring in-space propulsion and high power levels. We continue to stress that the coordination of science requirements and technical developments in the JIMO project is of paramount importance for success.

Advanced Technology

SScAC has expressed a long-term interest in the formulation and execution of a well-integrated advanced technology roadmap and budget. Our concerns have focused on the need for an appropriate planning process and procedures that ensure adequate funding of advanced technologies directly linked to scientific mission requirements.

SScAC offers the following recommendations as you put the Science Mission Directorate into place.

- 1. Formulate, implement, and update an integrated science technology plan through a process that coordinates the Science Mission Directorate, The**

Exploration Systems Mission Directorate and the Advanced Planning and Integration Office. This planning process could be integrated with the capabilities assessments being compiled for the Director of Advanced Planning.

- 2. Identify in the FY 2006 budget of the Science Mission Directorate separate line items for (a) crosscutting technologies and (b) mission-focused technologies.**
- 3. Establish a senior staff position focused on advanced technology.**

Suborbital Program

The suborbital program has served the needs of the nation for decades. However, despite strong support from the user community in general and NASA's advisory structure in particular, the program has not met user needs in recent years and the prognosis is very bleak. The large decrease to the sounding rocket portion of the program proposed in the President's FY05 budget has resulted in the untimely cancellation of an approved science investigation. Furthermore a plan calling for future cut backs will greatly compromise the value of the program for the space science community. **This recognition leads SScAC to endorse the plans to conduct a zero-based review of the suborbital program.** The committee further desires that the review result in a plan that will allow the needs of the program's main customer, the Science Mission Directorate, to be met in the best possible manner. These needs include science excellence and fiscal responsibility. In this context science excellence refers not only to the science performed directly by suborbital missions, but also training of scientists and development of technology.

Education and Public Outreach

The E/PO efforts within the Office of Space Science have been a great success due in part to outstanding leadership and the strong support of SScAC. As pointed out by the SScAC E/PO Task Force, the *direct* involvement of space scientists in the E/PO activities has been critical to its success. Because these key scientists are uniquely capable of communicating the excitement and discoveries from space science missions and research programs, keeping them intimately and personally involved in the E/PO activities is of the utmost importance. We are particularly concerned that the reassignment of key E/PO managerial positions from beneath the purview of former OSS and the growing difficulty of recruitment of E/PO IPAs, because they will not now be working within the Space Sciences Directorate, could lead to a deterioration in the quality of the program.

The SScAC has strongly supported Space Science E/PO efforts, including requiring that a committee member specifically represent the interests of the education community and act as a liaison with the NASA Education Advisory Committee.

SScAC also notes that the former OSS policy of mandating a small fraction of its funding for E/PO has transformed both the way E/PO is done, and how E/PO is perceived. Space Science E/PO has become an intimate facet of each and every Space Science mission and program. This is arguably one reason that Space Science has been the most visible and successful division of NASA. The combination of Space- and Earth-science E/PO activities under one Science Mission Directorate umbrella is an opportunity to merge successful policies and activities.

SScAC recommends:

- 1. The Science Mission Directorate should continue to carry out a robust E/PO program.**
- 2. The Science Mission Directorate should continue the OSS policy that at least 1 percent of the budget of each new SMD mission and program be devoted to E/PO activities.**
- 3. The Science Mission Directorate should look to the demonstrably successful Space Science E/PO program as a model from which to proceed with its combined E/PO activities in the future.**
- 4. In the Science Mission Directorate advisory structure, at least one member should be included who is an advocate for and representative of the E/PO community, as is the current policy for SScAC.**

Explorer Program

For nearly 50 years, the Explorer Program has consistently yielded scientific triumphs for NASA. The remarkable discoveries made by WMAP, TRACE, GALEX, IMAGE, RXTE, and RHESSI, for example, have made international headlines by triggering fundamental breakthroughs in understanding our entire universe, from Earth's auroral displays to the earliest echoes of the Big Bang. The Explorer program provides irreplaceable benefits beyond its scientific harvest, including the advancement in space technology and the professional training and advancement of scientists, engineers, and managers needed for a robust and healthy national space enterprise. The budget cuts imposed recently on this highly productive and cost-effective component of the Science Directorate endanger its future scientific and technological advances, and leave a significant gap in the Directorate's carefully planned mix of mission sizes and scopes.

SScAC strongly recommends that the Science Directorate restore and maintain a healthy level of funding for the Explorer Program.

Terrestrial Planet Finder

The Origins Subcommittee reported on NASA's decision to pursue two separate, sequential Terrestrial Planet Finder (TPF) missions: TPF-C (a coronagraph) and TPF-I (an interferometer). This is potentially an important advance for TPF, and represents a major milestone, as well as a significant change in scope of the mission. It is likely that each of these missions will be comparable to or larger than JWST in cost. Because this is a major step forward for one of our key astrophysical missions, and may have an impact on other parts of the science program, **SScAC requests a briefing from the project at its next meeting so as to better understand the technical advances and other factors that led to the decision, as well as the scope and requirements for the two missions.**